

the new Houses of Parliament, and the neighbouring buildings, as they seem to me to furnish their own comment.

In conclusion, I beg to add that I still remain in the same opinion as I expressed in my report to the Fine Arts Commission, as to the necessity of a new superstructure to Westminster-bridge upon the principles therein advocated; and as a favourable opportunity was afforded of carrying into effect that great public improvement, at an outlay moderate when compared with its importance, I trust the commissioners will not be indisposed to take my recommendation upon this subject into their most serious consideration.

I have the honour to be, Sir,

Your very obedient servant,
CHARLES BARRY.

The Right Hon. Charles S. Lefevre,
Speaker of the House of Commons,
Chairman of the Commissioners of
Westminster-bridge.

P.S.—To show the effect of the further reduction of the height of the bridge, which I have stated in this letter to be practicable, and to exhibit several modifications of my original design, partly with a view to economy, I forward to you the accompanying drawing for the consideration of the board.

Want of space compels us to postpone till next week our own remarks.

COLLIERY ENGINEERING—ITS RISE AND PROGRESS.

BY MATTHIAS DUNN, ESQ., C.E.

(Read at the Newcastle Mechanics' Institute.)

HAVING had the honour of being elected one of your vice-presidents, and having observed the great loss which the society sustains because of the want of scientific papers or lectures, whereby an impetus may be given, and the latent talent which exists among your body drawn out; I am induced to volunteer some observations upon the subject of colliery engineering, founded chiefly upon my own professional experience, both in this and other districts of the country, during the last forty years, coupled with traditionary and parole information as to the more early periods.

FIRST ERA.

STATE OF THE COAL-TRADE AT THE CLOSE OF THE SEVENTEENTH CENTURY AND THE COMMENCEMENT OF THE EIGHTEENTH CENTURY.

The only districts in the north of England from whence coal was shipped at this period, were the rivers Tyne, Wear, and Blyth. In the year 1699, the Tyne had two-thirds of the whole trade, employing about four hundred keels, and vending 300,000 chaldrons per annum. The over-sea trade, it is said, employed 900,000 tons of shipping. Sunderland, during fifty years preceding—viz., from about 1654, had risen into considerable importance. The districts then yielding the principal supply of Tyne coal were Ravensworth, and the numerous collieries delivering into keels at Derwenthaugh—viz., Pontop Pike, Marley Hill, Tafford Moor, Gareshead, Gluside, Axwell, Blaydon Main, and the neighbourhood of Wylington. Further west again were Grand Lease, (Stella,) Chupwell, Hedley, Wylam, Throckley, Walbottle, Denton, Benwell, Fenham, &c., above bridge; and below bridge were Felling, Gateshead, Heworth, Byker, Jesmond, Heaton, St. Lawrence, Denton, &c.; Hedley Fell was working in 1727, the coal being led down to Stella; in 1755, Jesmond colliery was laid in—it was at that time drained by two pumping engines. The river Wear was supplied from the collieries of the Lambton and Tempest estates; the districts up Chester Burn, Chattershaugh, Fattfield, Birtley, &c., all delivered into keels in the neighbourhood—the staiths extending from Cox green to Chattershaugh. From the same state of the trade, it was necessary to hold, from time to time, large stocks of coals, and to be ready to give quick despatch, to suit sudden and other emergencies; hence those extensive erections called staiths, many of which remain to the present day. The shale of keel

does on the Tyne was fired in 1710 as follows:—A vessel above Ouseburn, per tide, 6s. 4d.; below Ouseburn, 6s. 8d.; Shadwell's Ho, 7s. 6d.; Saint Anthony's 7s. 8d.; Widdicollie, 9s.; Jarrore and Howden, 11s. 8d.; Shields, 13s. 4d. The coals were all brought from above bridge, or from the shore near Newcastle. Notwithstanding the great distances from which the coals in those days were brought, the waggon-ways were all of wood, and even the wheels of the waggons were of the same material. The waggon-ways were constructed of a double tier of rails (the top one always of oak or beech, as best calculated to stand the alterations of wet and dry) and laid upon wooden sleepers, to which they were pinned with wood. These waggon-ways were most rudely constructed, being laid nearly according to the undulations of the surface; for the idea of inclined planes had not at this period entered into the head of man. In 1745 the cost of a yard of wooden way was 4s. 2d.—viz., two yards of oak rails, 1s. 2d.; three sleepers, 3s. 6d.; pins, 6d.; laying, 6d.; filling and ballasting, 2d. The cost of a twenty-bull waggon in 1723 (then a good deal used) was 7l. 1s. 2d. The waggons were governed by convays, bearing upon a single wheel; and, in order to prevent the wear of the wheels, which were extremely expensive to maintain, they were studded thick with nails, driven up to the heads; but the wear was proportionally great upon the breasts of the convays, which was a source of great labour and expense; the breaking of the waggons down the many rude steps was attended with continual loss of life, both to man and horse. Cast-iron rails for waggon-ways were introduced in 1767 at Colebrook Dale. In 1776, Mr. Curr invented his underground tramways. The coals were drawn from the mines by iron machines, called gin-wheels, constructed (though, perhaps, it was an improvement on one still earlier) being called a cog and rang gin, the horse wheel being vertical and toothed; it turned a horizontal shaft, lying over the pit, to which the ropes were attached. This machine was then but of recent introduction, the more ebb pipe being wrought by hand windlasses or jacks. In 1785, the price of drawing by gin, with a sixteen-pieck corf, for thirty fathoms was 10d. per four tons and three-quarters, and 1d. for every five fathoms of additional depth. The whim-gin was an improvement upon the complex combination of the cog and rang, and has universally superseded it.

The drainage of the mines at the time we are speaking of mainly depended upon day-levels or adits; sometimes it was effected by means of horses and chain pumps, and in certain instances water advantage could be taken of a running stream, or of water from a higher altitude, a water-wheel was employed—parts of Heaton and Jesmond, for instance, were won by means of a water-wheel, wrought by the stream of the adjoining burn. In 1690, Mr. Bald writes, that water-wheels and chains of buckets were commonly employed to drain collieries in Scotland. The axle of the wheel was steered across the pit-mouth, and small wheels were fixed upon the axle, to receive endless chains of two or three tiers, which reached down to the coal; to these chains were attached a number of riblong wooden buckets or troughs, in horizontal position, which circulated continually with the chains, ascending on one side and descending on the other, alternately full and empty, discharging as they turned over the wheel on the great axle-tree. A smaller machine of the sort was occasionally worked by horses, as well as by windmills. The steam-engine for draining mines was introduced early in the last century; the first was erected at Oxclee, the second at Norwood, near Ravensworth, and the third at Byker, in 1714; in 1720, it had come into general use. It was invented or introduced by the son of a Swedish nobleman, who taught mathematics in Newcastle. The art of self-government was not then discovered; the engine was wrought by the alternate opening and shutting of cocks by an attendant; but about four years afterwards (in 1718) a person of the name of Beighton invented the means of producing the desired effect from the machine itself. These engines were on Newcomen's principle—an open-topped cylinder, the vacuum being created underneath the piston by injecting cold water into the cylinder, and

resulting an effective pressure of from 4lb. to 5lb. per inch on the safety-valve. Mr. W. Brown, of Throckley, a celebrated stevedore of that day (according to a manuscript in my possession), was remarkably conspicuous in the introduction of the steam-engine to this colliery district; in 1756, upon getting the management of Throckley colliery, he built one there—then a great rarity; in 1757, one at Birtley North Side, one at Lambton, and one at Byker; in 1758, two at Walker, and one at Bell's Close; in 1759, one at Heworth; in 1760, two at St. James Moor, and one at Birtley; in 1762, one at Oxclee, one at Beamish, and one at Beasel (which had not only three boilers, but twenty-four inch wooden pumps formed of staves eighteen-inch diameter); in 1764, one at North Biddick, one at Low Fell, and three in Scotland—viz., one at Burrows-town, one at Fittenween in Fifehire, and one near Mureburgh; in 1766, one at Lambton; in 1772, one at Fattfield; in 1775, two at Wylington, and one near Washington, with its house contrived to take in a second; in 1776, one at Felling. The present Alderden engine, at Ravensworth, was built about 1780, up to which period scarcely any pump exceeded eight-inch or nine-inch diameter, and scarcely any engine had more than a single half-stack boiler.

The coals in the early period of mining were invariably drawn in corves or baskets; the trams had broad wooden wheels; the tramways were constructed of three planks, the upper one forming an elevated ledge, for the guidance of the tram. Horses were as yet scarcely introduced underground; but when they were, the roads were constructed in the same manner as those above ground, the rollers carrying two or three corves each. Screens were not at this time invented. All the produce of the mines was sold, save what was required by the engines and workmen. The first screen said to have been introduced by Mr. W. Brown, at Wylington Colliery, about the year 1740. The coal price did not exceed 10s. per Newcastle chaldron; yet from the lowness of wages, and the cheapness of materials, collieries were productive of profit, and after the introduction of steam-engines, became objects of general attention. However wages were from 1s. 6d. to 1s. 10d. per day, and those of other workmen in proportion. In 1714, Frier's Goose coals sold for 11s. per chaldron, and the cost of a chaldron waggon was 9d. In 1745, the bawing price of Lumley Main coal was 1d. per peck, or 1s. 9d. per four tons and three-quarters—the twelve-pieck corf was used for the convenience of drawing with gins; the Byker Main coal (twenty-pieck corf) was 1s. 4d. per four tons and three-quarters, weighing 10d.

The art of ventilation was little known, especially the underground furnace; but the working of the coal was confined to the seams at shallow depths, and in which inflammable air existed in any small degree; still, because of the ignorance of ventilation, explosions were frequently happening, even in those days, and gradually called into existence air-tubs, retreating furnaces, &c. In 1732, five lamps or furnaces were first known at Fattfield Colliery, where many serious explosions took place. In 1756, the first air-tube was built at North Biddick Colliery, Mr. William Allison being then the viewer. The cost of boring in 1740 was 5s. per fathom for the first five fathoms, and 5s. per fathom extra every successive fathom, through a three-inch diameter, for thirty-one fathoms. Blasting by gunpowder was then in its infancy—many pits and drifts having been executed simply by the hack and the wedge. Whilst the steam-engine was imperfectly understood, the collieries in operation were necessarily those whose seams were lying a short way from the surface, and not burdened with any considerable quantities of water—for the only pumps in use were bored from solid wood, and the diameter was consequently confined to eight or ten inches; the joints were pig-iron and lasset, and there was a difficulty in keeping them tight when the pressure exceeded twenty-five fathoms. As no means were devised of stopping backshaft water, the only relief that could be made available was by means of off-shaft drifts—the engine-pits being, where practicable, sunk convenient for such purposes. The coals of the largest on the Tyne and Wear were nearly of the same construction as at present; but their rig, not only at the time first mentioned, but